CLAIMS

1. An earth-boring drill bit for drilling a borehole of a predetermined gage, the bit comprising:

(a) a bit body having a bit axis;

(b) a plurality of rolling cone cutters, each rotatably mounted on the bit body about a respective cone axis and having a plurality of rows of cutting inserts thereon;

(c) the plurality of rows comprising a gage row with gage inserts located such that the gage row is ~~the first row of inserts~~ from the bit axis that cuts substantially to the predetermined gage and cuts the bottom of the borehole corner substantially unassisted, the gage inserts having a generally cylindrical base portion secured in the cone and defining an insert axis that is at an acute angle with respect to the cone axis, and a cutting portion extending from the base portion, the cutting portion comprising a generally convex gage cutting surface with a center axis, at least a portion of the gage cutting surface enhanced with a super abrasive material.

2. The drill bit of Claim 1 wherein the center axis of the gage cutting surface is at an acute angle with respect to the cone axis.

3. The drill bit of Claim 2 wherein the insert axis is aligned with the center axis of the gage cutting surface.

4. The drill bit of Claim 1 wherein the cutting portion is axisymmetric about the insert axis.

5. The drill bit of Claim 4 wherein the cutting portion is generally hemispherical.

6. The drill bit of Claim 1 wherein the cutting portion is non-axisymmetric about the insert axis.

7. The drill bit of Claim 6 wherein the gage cutting surface is axisymmetric about its center axis.

8. The drill bit of Claim 6 wherein the gage cutting surface is generally hemispherical.

9. The drill bit of Claim 6 wherein the gage cutting surface is generally conical.

10. The drill bit of Claim 6 wherein the gage cutting surface is generally bullet-shaped.

11. The drill bit of Claim 1 wherein the super abrasive material comprises polycrystalline diamond.

12. The drill bit of Claim 1 wherein the gage cutting surface is enhanced with a layer of the super abrasive material.

13. The drill bit of Claim 12 wherein the layer of the super abrasive material is of a varying thickness with a maximum thickness and a minimum thickness and the layer contacts gage where its thickness is closer to the maximum thickness than the minimum thickness.

14. The drill bit of Claim 13 wherein the cross-section of the layer of super abrasive material is generally crescent shaped.

15. The drill bit of Claim 12 wherein the cutting portion is fully capped by the layer of super abrasive material.

16. The drill bit of Claim 12 wherein the layer of super abrasive material has an edge and a center and wherein the layer contacts gage at a point closer to the center than the edge.

17. The drill bit of Claim 5 wherein the angle between the insert axis and the radius of the generally hemispherical cutting portion through its point of contact at gage is between about 0 and about 50 degrees.

18. The drill bit of Claim 17 wherein the angle is between about 25 degrees and about 40 degrees.

19. The drill bit of Claim 17 wherein the angle is between about 15 degrees and about 45 degrees.

20. The drill bit of Claim 8 wherein the angle between the insert axis and the radius of the generally hemispherical gage cutting surface through its point of contact at gage is between about 0 and about 50 degrees.

21. The drill bit of Claim 20 wherein the angle is between about 25 degrees and about 40 degrees.

22. The drill bit of Claim 20 wherein the angle is between about 15 degrees and about 45 degrees.

23. The drill bit of Claim 1 further comprising at least one additional row of inserts that cuts fully to the predetermined gage.

24. An earth-boring drill bit for drilling a borehole of a predetermined gage, the bit comprising:

(a) a bit body having a bit axis;

(b) a plurality of rolling cone cutters, each rotatably mounted on the bit body about a respective cone axis and having a plurality of rows of cutting inserts thereon;

(c) the plurality of rows comprising a gage row with gage inserts located such that the gage row is the first row of inserts from the bit axis that cuts substantially to the predetermined gage when the bit is new, the gage inserts having a generally cylindrical base portion secured into the cone and defining an insert axis, and a cutting portion extending from the base portion comprising a generally hemispherical gage cutting surface with a center axis and with at least one layer of super abrasive material thereon, the insert axis forming an angle with the radius of the gage cutting surface through its point of contact at gage between about 0 degrees and about 50 degrees.

25. The drill bit of Claim 24 wherein the angle is between about 0 degrees and about 40 degrees.

26. The drill bit of Claim 24 wherein the angle is between about 25 degrees and about 40 degrees.

27. The drill bit of Claim 24 wherein the angle is between about 15 degrees and about 45 degrees.

28. The drill bit of Claim 24 wherein the center axis of the gage cutting surface is canted with respect to the base portion.

29. The drill bit of Claim 28 wherein the insert axis is normal to the cone axis.

30. The drill bit of Claim 28 wherein the cutting portion comprises a wedge-shaped portion transitioning between the base portion and the gage cutting surface such that the gage cutting surface has a generally circular footprint.

31. The drill bit of Claim 28 wherein the gage cutting surface has a generally elliptical footprint.

32. The drill bit of Claim 24 further comprising at least one additional row of inserts that cuts fully to the predetermined gage.

33. An earth-boring drill bit for drilling a borehole of a predetermined gage, the bit comprising:

(a) a bit body having a bit axis;

(b) a plurality of rolling cone cutters, each rotatably mounted on the bit body about a respective cone axis and having a plurality of rows of cutting inserts thereon;

(c) one of the rows being a gage row with gage inserts located such that it is the first row of inserts from the bit axis that cuts substantially to the predetermined gage when the bit is new, the gage inserts having a generally cylindrical base portion secured in the cone and defining an insert axis that is at an acute angle with respect to the cone axis, and a cutting portion extending from the base portion, the cutting portion comprising a generally convex gage cutting surface with a center axis, at least a portion of the gage cutting surface enhanced with a super abrasive material.

34. The drill bit of Claim 33 wherein the cutting portion is axisymmetric.

35. The drill bit of Claim 34 wherein the cutting portion is generally hemispherical.

36. The drill bit of Claim 34 wherein the cutting portion is generally conical.

37. The drill bit of Claim 34 wherein the cutting portion is generally bullet-shaped.

38. The drill bit of Claim 33 wherein the cutting portion is non-axisymmetric about the insert axis.

39. The drill bit of Claim 38 wherein the gage cutting surface is axisymmetric about its center axis.

40. The drill bit of Claim 38 wherein the gage cutting surface is generally hemispherical.

41. The drill bit of Claim 38 wherein the gage cutting surface is generally conical.

42. The drill bit of Claim 38 wherein the gage cutting surface is generally bullet-shaped.

43. The drill bit of Claim 33 wherein the super abrasive material comprises polycrystalline diamond.

44. The drill bit of Claim 33 wherein the gage cutting surface is enhanced with a layer of the super abrasive material.

45. The drill bit of Claim 44 wherein the layer of the super abrasive material is of a varying thickness with a maximum thickness and a minimum thickness and the layer contacts gage where its thickness is closer to the maximum thickness than the minimum thickness.

46. The drill bit of Claim 45 wherein the cross-section of the layer of super abrasive material is generally crescent shaped.

47. The drill bit of Claim 44 wherein the cutting portion is fully capped by the layer of super abrasive material.

48. The drill bit of Claim 44 wherein the layer of super abrasive material has an edge and a center and wherein the layer contacts gage at a point closer to the center than the edge.

49. The drill bit of Claim 35 wherein the angle between the insert axis and the radius of the generally hemispherical cutting portion through its point of contact at gage is between about 0 and about 50 degrees.

50. The drill bit of Claim 49 wherein the angle is between about 25 degrees and about 40 degrees.

51. The drill bit of Claim 49 wherein the angle is between about 15 degrees and about 45 degrees.

52. The drill bit of Claim 40 wherein the angle between the insert axis and the radius of the generally hemispherical gage cutting surface through its point of contact at gage is between about 0 and about 50 degrees.

53. The drill bit of Claim 52 wherein the angle is between about 25 degrees and about 40 degrees.

54. The drill bit of Claim 52 wherein the angle is between about 15 degrees and about 45 degrees.

55. The drill bit of Claim 33 further comprising at least one additional row of inserts that cuts fully to the predetermined gage.

56. A cutting insert for use in an earth boring drill bit, comprising:

(a) a generally cylindrical base portion defining an insert axis;

(b) a cutting portion extending from the base portion comprising a generally convex gage cutting surface, the gage cutting surface having a center

axis and being axisymmetric about such, the gage cutting surface enhanced with a super abrasive material, the center axis of the gage cutting surface canted with respect to the insert axis of the base portion.

57. The cutting insert of Claim 56 wherein the cutting surface is generally hemispherical.

58. The cutting insert of Claim 56 wherein the center axis is canted with respect to the insert axis by at least about 5 degrees.

59. The cutting insert of Claim 56 wherein the center axis is canted with respect to the insert axis by at least about 10 degrees.

60. The cutting insert of Claim 56 wherein the insert comprises a wedge-shaped portion transitioning between the base portion and the cutting surface such that the cutting surface has a generally circular footprint.

61. The cutting insert of Claim 56 wherein the cutting surface has a generally elliptical footprint.

62. The cutting insert of Claim 56 wherein the super abrasive material comprises polycrystalline diamond.

63. A method of making the cutting insert of Claim 53 comprising the steps of:

(a) making an insert with a generally cylindrical base portion defining an insert axis and a generally hemispherical cutting portion with an apex coincident with the insert axis;

(b) cutting the base portion at an oblique angle with respect to the insert axis to create a top that includes the cutting portion and some of the base portion and a bottom that includes the remainder of the base portion;

(c) rotating the top about 180 degrees with respect to the bottom about the insert axis; and

(d) attaching the top to the bottom to generally match the elliptical footprints of the top and the bottom.